? JOHN DAY *The* reason why *Series*

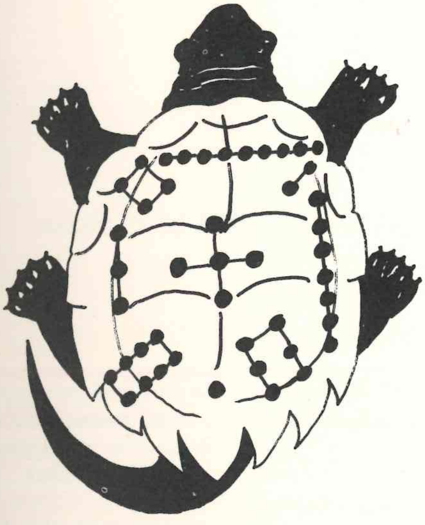
Numbers OLD *and* NEW

by IRVING and RUTH ADLER

illustrated by Peggy Adler

NUMBERS
OLD AND NEW

Irving and Ruth Adler



Illustrated by Peggy Adler

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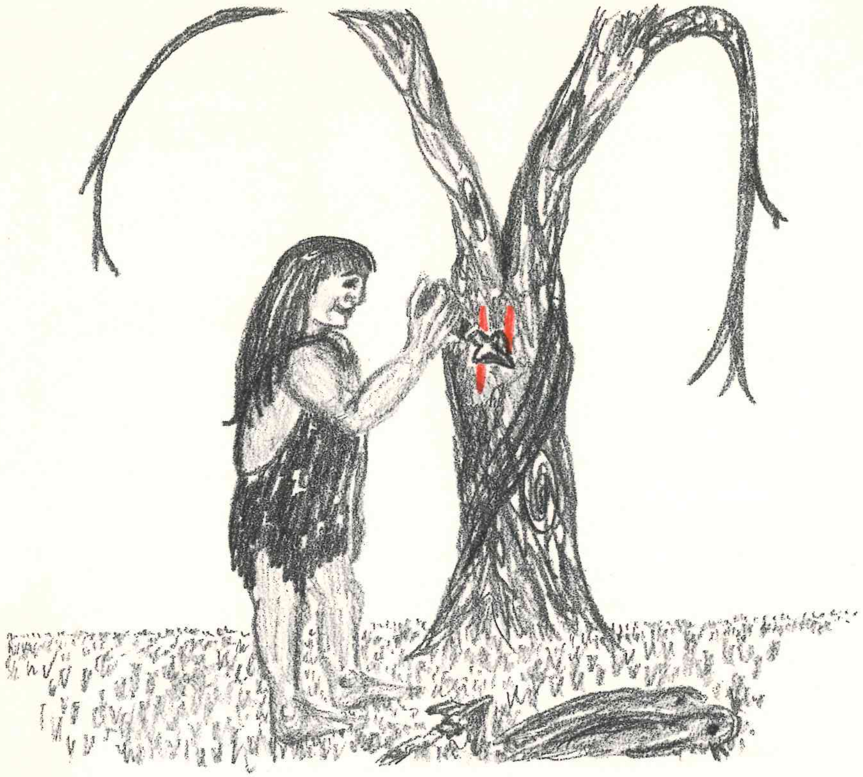
Numbers Old and New

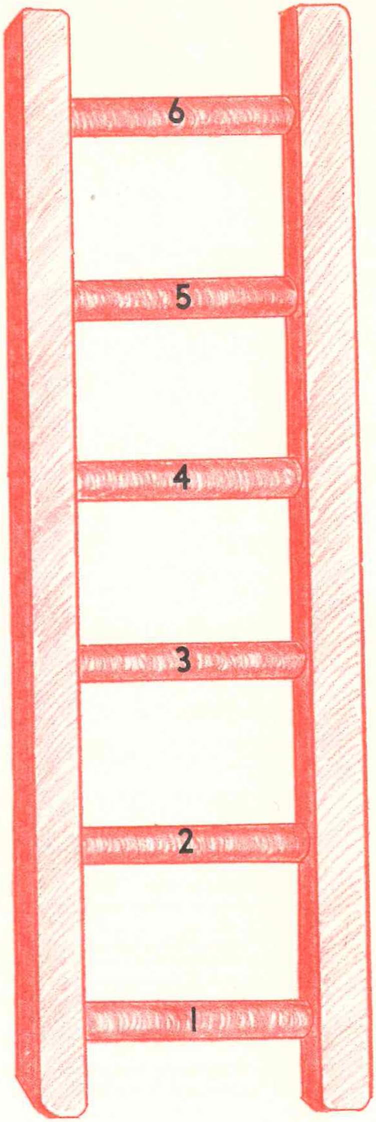


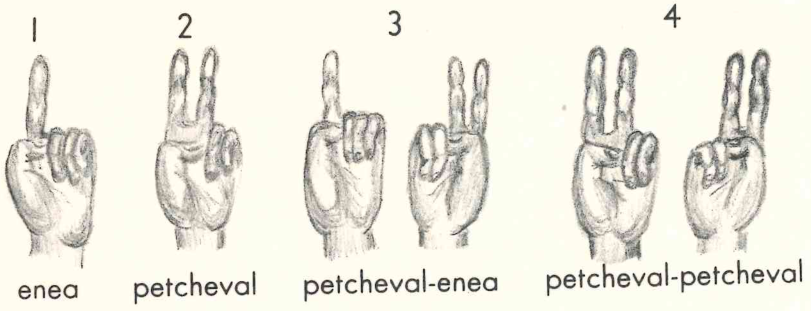
The Ladder of Numbers

Ten thousand years ago, there were no factories, farms, or stores. People got their food by hunting. They could not read or write. And they did not know much about numbers. Some of them had words for "one" and "two." But they did not have any words for "three" or "four" or any higher numbers. They could count as high as two. For all numbers above two they said "many."

As the years passed, people learned how to do more things. They began to grow grains and raise animals. They made many products in their workshops, and began to buy and sell some of them. They often had to count or measure or figure. So they learned more about numbers. They made up new names for new numbers. They also invented ways of writing them.

There is no end to the amount of numbers we have. The numbers we use for counting go on and on. They are like the rungs of a ladder. The number *one* is like the first rung. The number *two* is like the second rung. Counting is like climbing up the ladder. After each number, there is always a next number. So this ladder has no top.



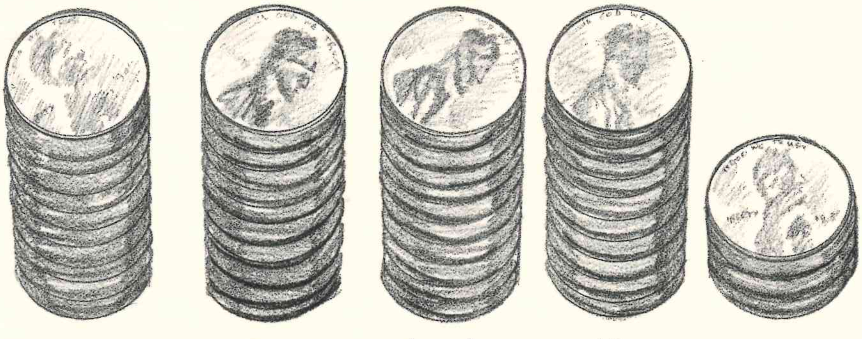


Counting in Groups

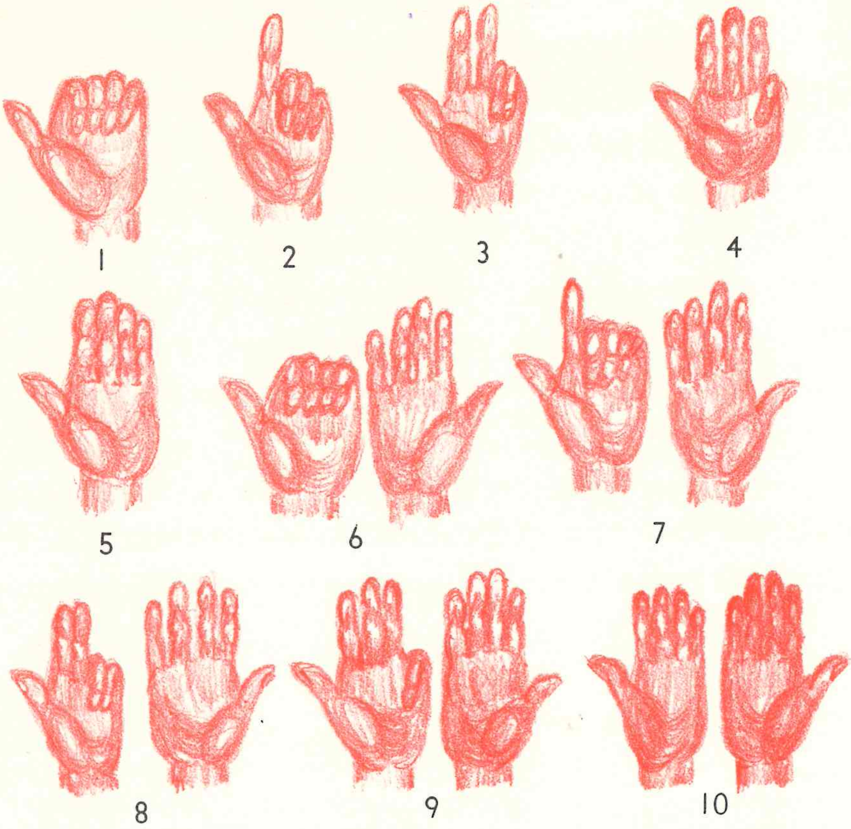
We need a name for each number in the ladder of numbers. If we used a new word for each new number, pretty soon we would run out of words. To avoid this trouble, people began counting things out in small groups. They could make up names for large numbers by putting together the names of small numbers. For example, a tribe of hunters in Australia counts things in groups of two. Their word for one is *enea*. Their word for two is *petcheval*. They do not have a special word for three. They call it *petcheval-enea,* which means two and one. For the number four they say *petcheval-petcheval,* which means two and two.

We count things in groups, too, But we use groups of ten. This is shown in the names we use for many of our numbers. For the next number above twelve we say *thirteen.* This word is made up of two parts. The *thir* means *three,* and the *teen* means *ten.* So *thirteen* means *three* and *ten. Fourteen* means *four* and *ten.* The word *twenty* is also made up of two parts. The *twen* means *two,* and the *ty* means *ten.* The two parts are put together to mean *two tens. Thirty* means *three tens. Forty* means *four tens,* and so on. When we say *forty-three,* we are really saying *four tens and three.*

To count a pile of pennies, first we make stacks with ten pennies in each stack. Then we count the stacks. If there are four stacks, and three extra pennies, then we know that the number of pennies is four tens and three, or forty-three.



Four tens plus three = 43



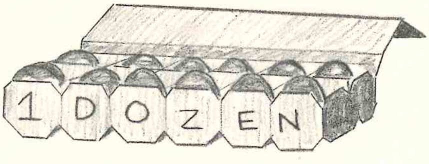
Why do we count things in groups of ten? The reason is that we have ten fingers. Long ago, when people had to count many things, they matched them against their fingers. First they counted out enough things to match the fingers of both hands. Then they put these things aside in one group. If there were more than ten things to count, they formed more groups. We might call our numbers two-handed numbers, because they grew out of counting things on two hands.

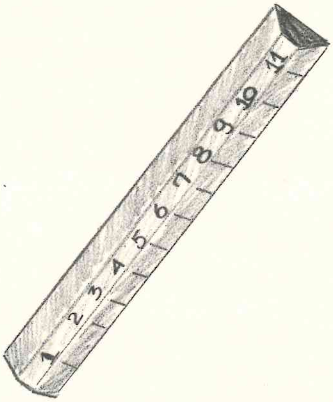
Some people had one-handed numbers, too. Because there are five fingers on one hand, they counted things out in groups of five. One-handed numbers were used by the people who lived in Italy over two thousand years ago. They were ruled from the city of Rome, so we call their written numbers *Roman numerals.* In Roman numerals, *I* stands for *one,* and *V* stands for *five.* To write *six,* the Romans wrote *VI,* which means *five and one.*

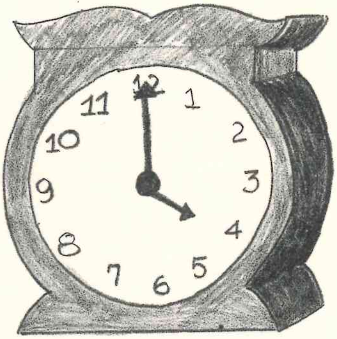
A long time ago, when people did not wear shoes, they could use their toes for counting, too. So some people had a barefoot arithmetic. They counted things out in groups of twenty. This was done, for example, by the Mayas, who ruled Mexico many hundreds of years ago.

Sometimes people counted things in groups of twelve. We still use the twelve-in-a-group system for some purposes. When we count out eggs, we count out twelve at a time, and call a group of twelve a *dozen.* When we measure lengths with a ruler, we count out *twelve inches* to make *one foot*. When we measure time with a clock, we count the hours from *one* to *twelve,* and then start with *one* all over again. The twelve-in-a group system has left its mark on our number names, too. We have a separate name for each number from one to twelve. We start using the ten-in-a-group system to name higher numbers only after we get above twelve.

Thousands of years ago



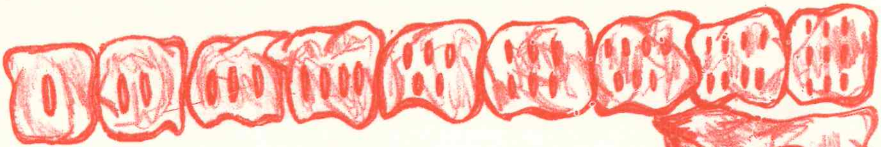




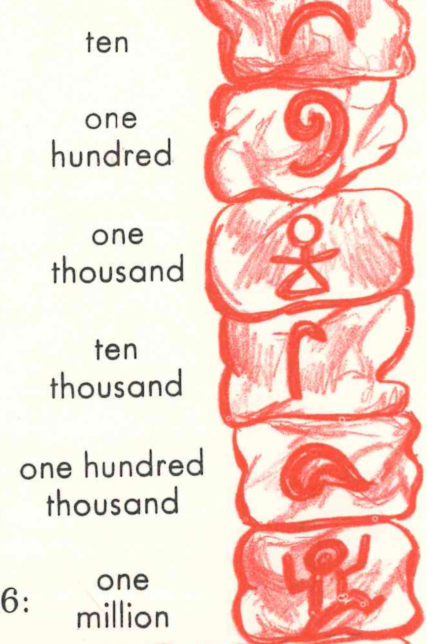
there was a country called Babylonia. The people of this country used to count things in groups of sixty. We still use the sixty-in-a-group system when we measure time. There are sixty seconds in a minute, and there are sixty minutes in an hour.

Old Ways of Writing Numbers

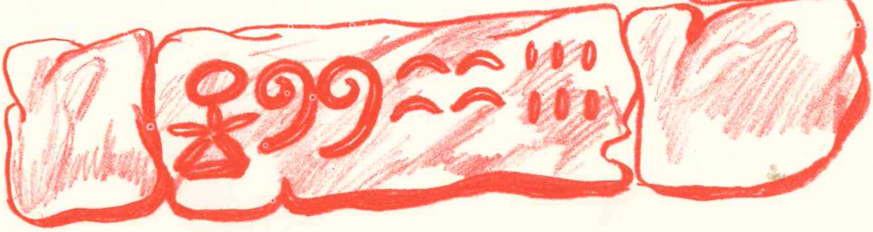
In Egypt, about five thousand years ago, the people used to write by making pictures. They carved these pictures on stone or wood. To write the number *one,* they made a straight line, as we do. This line is a simple picture of a *finger*. To write the numbers from *two* to *nine,* they used more straight lines, like this:



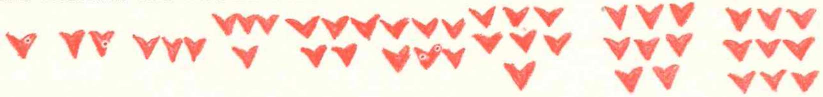
To write the number *ten,* they made a picture of a *heel bone*. For *one hundred,* they used a picture of a *coiled rope*. *One thousand* was shown by a *lotus flower*. *Ten thousand* was shown by a *bent finger*. A *fish* stood for *one hundred thousand*. A *man,* holding his hands up in wonder, stood for *one million*.



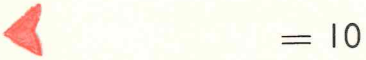
Here is how they wrote 1,246:

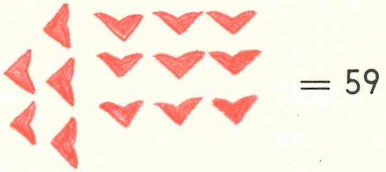


In Babylonia, about four thousand years ago, people used to write on soft clay. They used a wedge-shaped stick called a *stylus* to make dents in the clay. Then they baked the clay to make it hard. Here is how they wrote the numbers from one to nine:

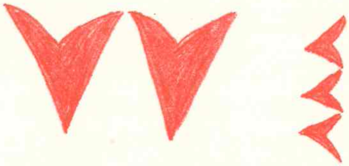


To write the number ten, they turned the stylus around, so the dent came out sideways. To write 59, they wrote five *tens* and *nine* ones.

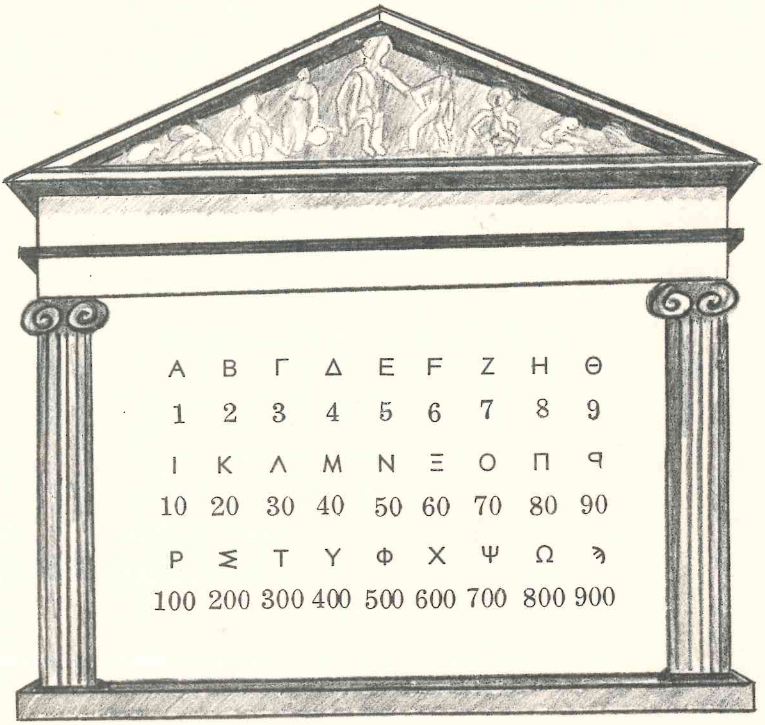




To write *sixty*, they used the same sign that they used for the number *one*. But they put it in a different place, next to the space where the smaller numbers were written. In the numeral below, each of the ones on the left stands for *sixty*. The number shown is two *sixties* and three *tens*, or 150:

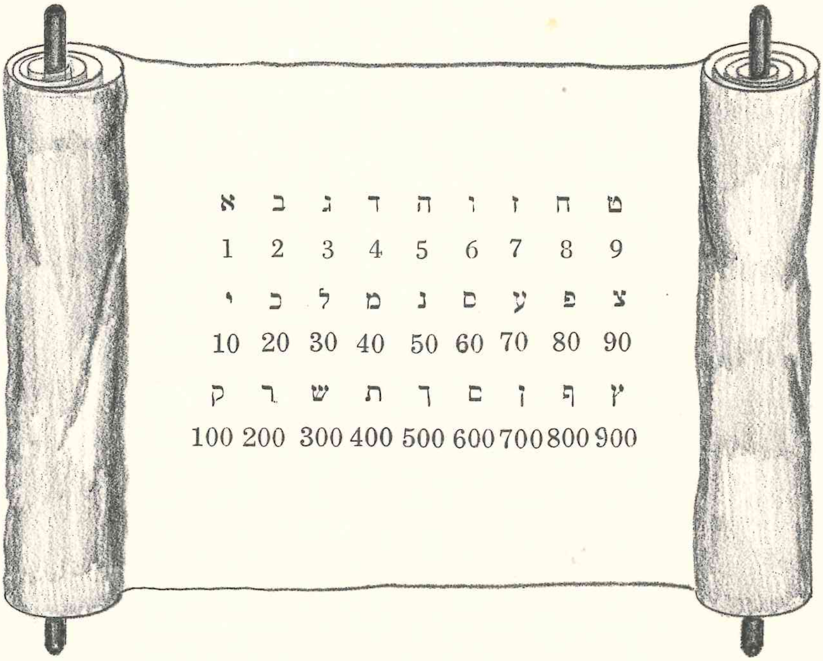


The ancient Greeks used the letters of their *alphabet* to stand for numbers. They had twenty-four letters in their alphabet. They borrowed three more letters from other alphabets. Then they had twenty-seven letters that they could use for numbers. Nine letters were used for the numbers from *one* to *nine*. Nine more were used for the tens, from *ten* to *ninety*. The last nine were used for the hundreds:



Α	Β	Γ	Δ	Ε	F	Ζ	Η	Θ
1	2	3	4	5	6	7	8	9
Ι	Κ	Λ	Μ	Ν	Ξ	Ο	Π	ϙ
10	20	30	40	50	60	70	80	90
Ρ	Σ	Τ	Υ	Φ	Χ	Ψ	Ω	ϡ
100	200	300	400	500	600	700	800	900

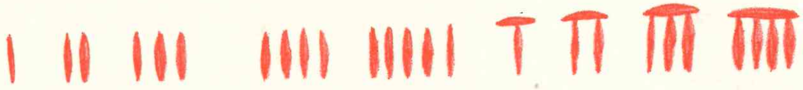
The ancient Jews used the letters of the Hebrew alphabet in the same way:



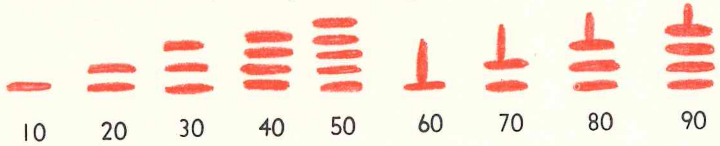
א	ב	ג	ד	ה	ו	ז	ח	ט
1	2	3	4	5	6	7	8	9
י	כ	ל	מ	נ	ס	ע	פ	צ
10	20	30	40	50	60	70	80	90
ק	ר	ש	ת	ך	ם	ן	ף	ץ
100	200	300	400	500	600	700	800	900

In this system, thirteen was written as יג , which meant ten and three. (Hebrew is read from right to left.) Fourteen was written as יד , which meant ten and four. But fifteen was *never* written as יה , or ten and five. יה are the first two letters of יהוה which means *Jehovah,* the Hebrew name for God. To avoid using the name of God as a number the Jews wrote fifteen as טו , or nine and six.

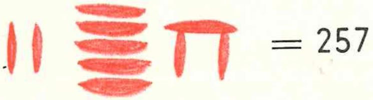
A long time ago, the Chinese used to write numbers by putting small rods on a counting board. Here is how they wrote the numbers from one to nine:



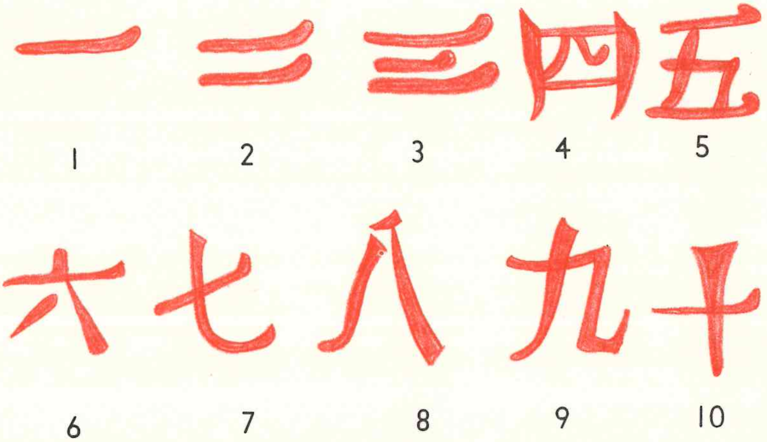
To show the tens, they arranged the sticks this way:



To show one hundred, they used the number one, placed to the left of the rods that stood for tens. They could tell that it stood for one hundred by seeing the place it was in. Here is how they wrote 257:



Later, Chinese numerals were written in ink like this:

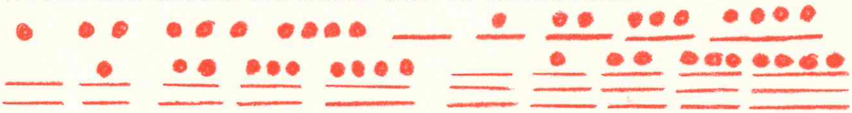


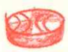
The Romans had special symbols for some numbers:

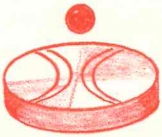
I	V	X	L	C	D	M
1	5	10	50	100	500	1000

They built other numbers by putting these symbols together. If they put a smaller number to the right of a larger one, it meant that they should be added. For example: VIII means five *plus* three, or *eight*. If they put a smaller number to the left of a larger one, it meant that they should be subtracted. For example, IV meant five minus one, or four. XL meant fifty minus ten, or forty.

The Mayans wrote numbers with dots and dashes. A dot meant *one*, and a dash meant *five*. This is how they wrote the numbers from one to nineteen:



They also had a zero, that looked like this: 
To write twenty, they wrote a dot, with a zero under it. To write twenty-one, they wrote a dot with another dot under it. The upper dot stood for twenty, while the lower dot stood for one. They could tell the meaning of each dot by seeing the place it was in.



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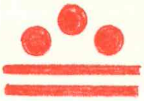
21



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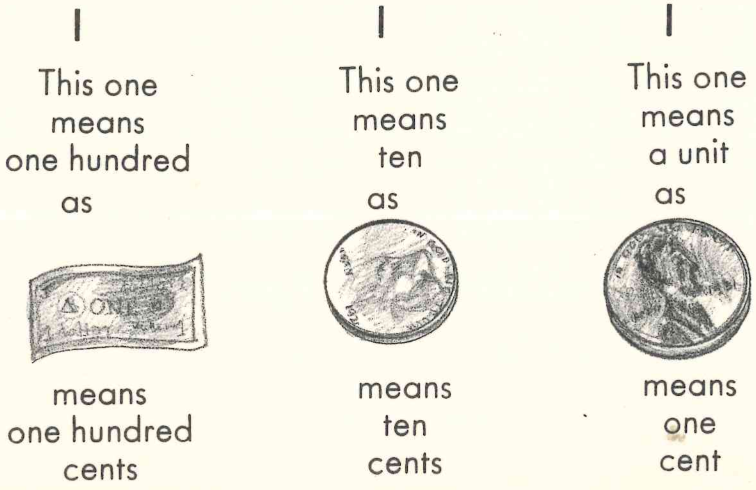
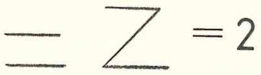
The New Way

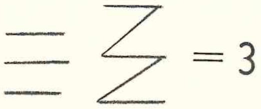
The numerals that we use are called *Arabic* numerals, because we got them from the Arabs. We use only ten symbols, 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. But we can write many more numbers with them because each symbol can have many meanings. In the numeral 111, each 1 has a different meaning. The first 1 on the right means 1 *unit*. The second 1 from the right means 1 *ten*. The third 1 from the right means 1 *hundred*. In our system, the meaning of a symbol depends on the place where it is written. It is called a *place value* system. The Babylonians, the ancient Chinese, and the Mayans also had a place value system.

To write the number *ten*, we put a 1 in the second place from the right. But we cannot tell that it is the *second* place unless there is something written in the *first* place. So we put 0 in the first place to mean *no units*. The Mayans used a symbol for zero, too. The Babylonians did not have a symbol for zero.

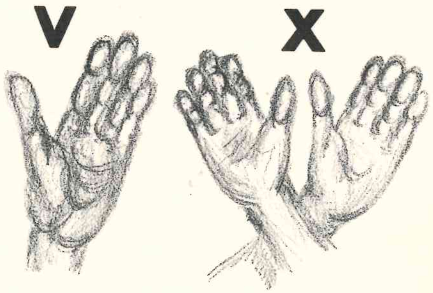

1
This one means one hundred as
means one hundred cents
1
This one means ten as
means ten cents
1
This one means a unit as
means one cent
ONE

The Arabic numerals didn't always look the way they do now. A long time ago, the numbers *two* and *three* were written by putting two or three lines under each other. But then, when people wrote quickly, they got into the habit of joining the lines.





The drawings on the side show how the Roman numerals for *five* and *ten* arose. The early Romans used to use one hand, or five fingers, to stand for *five*. They used two hands, or ten fingers, to stand for *ten*.



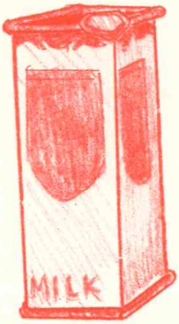
Today we use two different names for the symbol 0. One of them is *zero*. The other one, found in some old arithmetic books, is *cipher*. Both names come from the Arabic word *sifr*, which means *empty*. The word *sirf* was first brought to Europe about 700 years ago.

Broken Numbers

When we measure a length, we break it up into units, called *feet,* and then count the feet. But sometimes we have to measure a length that is smaller than one foot. Then we use a smaller unit, the inch. A long time ago, this was the only way in which people measured small amounts. They used small units, and then counted them. Later, they got the idea of keeping the old large units, and using new numbers to stand for parts of a unit. We call these new numbers *fractions.* The word *fraction* comes from the Latin word *frangere,* which means to break. Fractions are broken numbers used to measure broken units.

To measure liquids we use . . .

. . . the quart

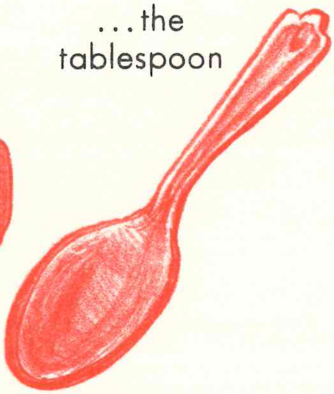


as a unit . . .

. . . the cup

as a smaller unit . . .

. . . the tablespoon



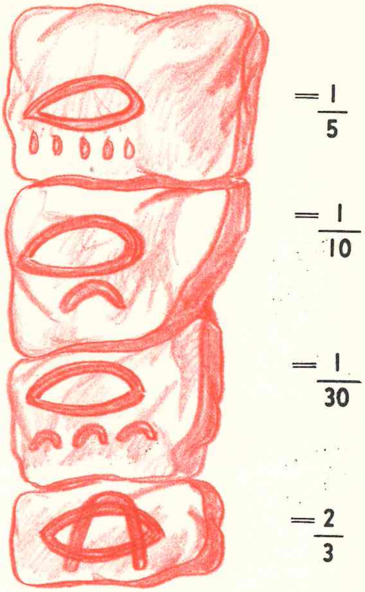
as a still smaller unit

The ancient Egyptians used to write fractions by using the whole numbers with the special symbol , that meant part. If was written over the number five, it meant one part out of five, which we now write as ⅕. Some of the Egyptian fractions are shown in the drawing.

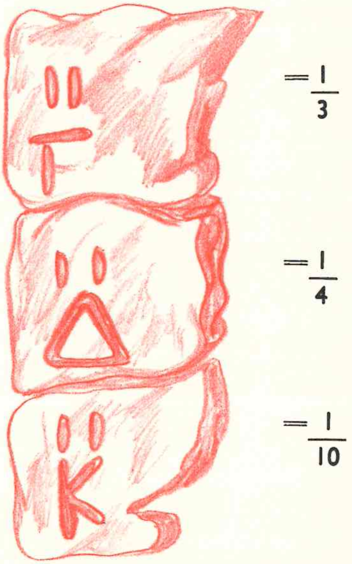
The ancient Greeks used the same kind of system to write fractions. They used the symbol ″ to mean part.

The system we use for writing fractions was invented by the Hindus. They passed it on to the Arabs, who passed it on to the Europeans and then to us.

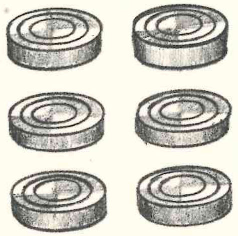
Egyptian Fractions



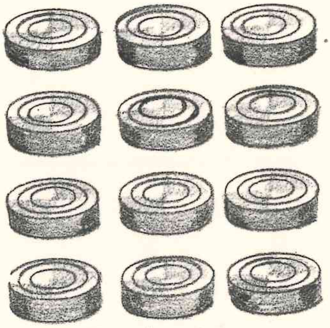
Greek Fractions



To show the number six, put six checkers on a table. They can be placed in three lines of equal length, one under the other, to form a *rectangle*. Twelve checkers can be placed in four lines to form a rectangle. Numbers that make a rectangle with more than one line in this way are called *rectangle numbers*. You can always get a rectangle number by multiplying two smaller numbers. For example, 6 = 3 × 2, and 12 = 4 × 3.



Six is a
rectangle number
3 x 2 = 6

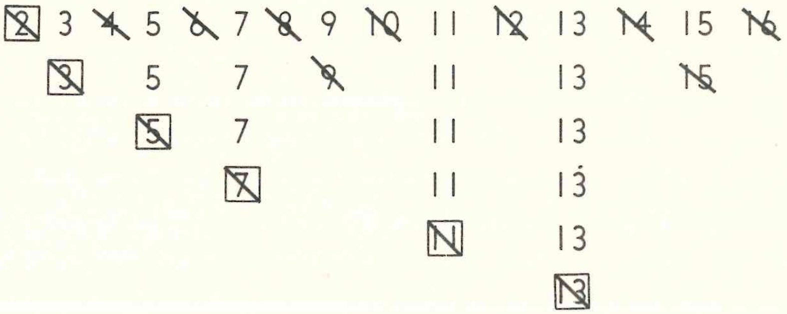


Twelve is a
rectangle number
4 x 3 = 12

There are some numbers that cannot make a rectangle with more than one line. For example, seven checkers can be put in one line. They cannot be put into two or more lines of equal length.

A number like this is called a *line number,* or a *prime number.*

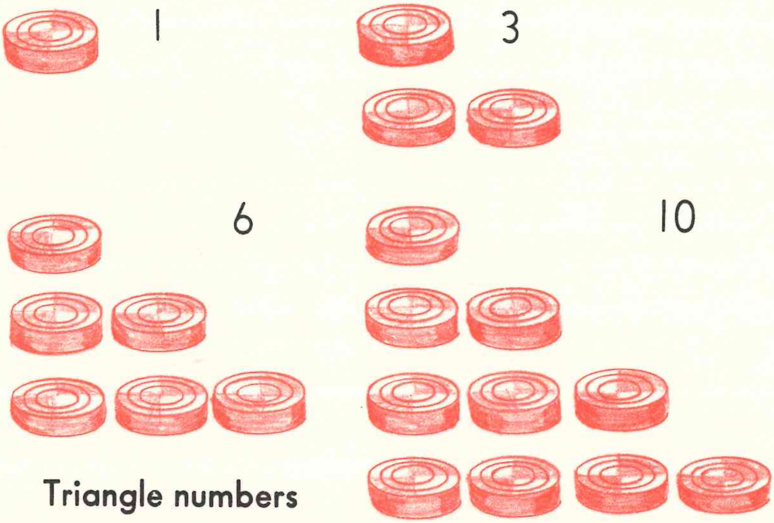
Eratosthenes, a wise man who lived in Greece a long time ago, thought up an easy way of finding the numbers that are prime. Imagine the counting numbers written down in order, starting with 2. The 2 is the first prime number. Now count by 2's, and cross out all the numbers you reach. The numbers that are left form a new list, starting with 3. The 3 is the second prime number. Now count by 3's, and cross out all the numbers you reach. The numbers that are left form a new list, starting with 5. The 5 is the third prime number. Now count by 5's, and so on. The first ten prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.



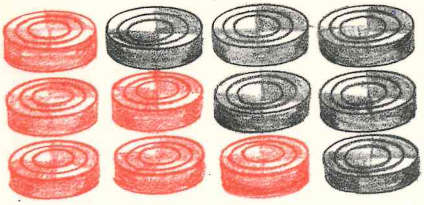
Finding the prime numbers. The first number on each line is a prime.

Arrange checkers in lines in this way. Put one checker on the first line, two checkers on the second line, three checkers on the third line, and so on. The lines of checkers make a *triangle*. If you use only one line, there is one checker in the triangle. If you use two lines, there are three checkers in the triangle. You need six checkers to make a triangle with three lines. Numbers that can be used to make triangles in this way are called *triangle numbers*. The first few triangle numbers are 1, 3, 6, and 10.

We can find out how many checkers there are in each triangle by counting them. There is also a short cut we



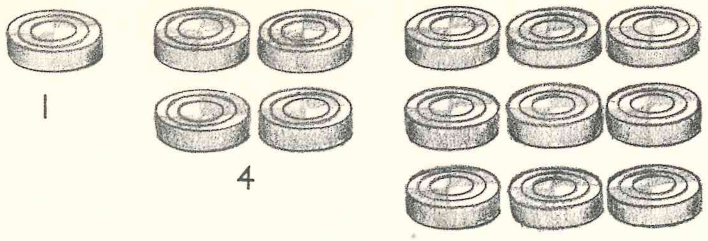
Triangle numbers



$6 = \frac{1}{2}$ of 3×4

can use. To find the number of checkers in one of these triangles, multiply the number of lines in the triangle by the next higher number. Then take half the product. For example, the fourth triangle has four lines. The next higher number is 5. So multiply 4 × 5 to get 20. Half of 20 is 10. So the fourth triangle number is 10. The twelfth triangular number is half of 12 × 13, or 78.

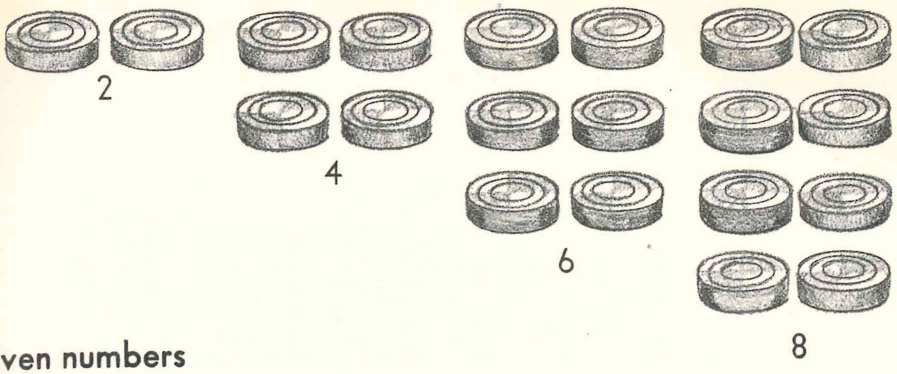
A teacher in a German school once asked his class to add all the counting numbers from 1 to 100. While the class began writing out all the numbers in order to add them, one boy wrote the answer down at once. He saw that the answer was a triangle number. He figured it out in his head by using the short cut: half of 100 × 101 = 5,050. The boy's name was Gauss. He grew up to be one of the greatest mathematicians in the world.



Square numbers

A square is a rectangle whose length and width are equal. A rectangle made of rows of checkers is a square if the number of rows is equal to the number of checkers in each row. A square with one row has only 1 checker in it. A square with two rows has 2 × 2, or 4 checkers in it. A square with three rows has 3 × 3, or 9 checkers in it. The numbers 1, 4, and 9 are called *square numbers*. Whenever you multiply a counting number by itself, you get a square number. The next square number after 9 is 4 × 4, or 16. What are all the square numbers between 1 and 100?

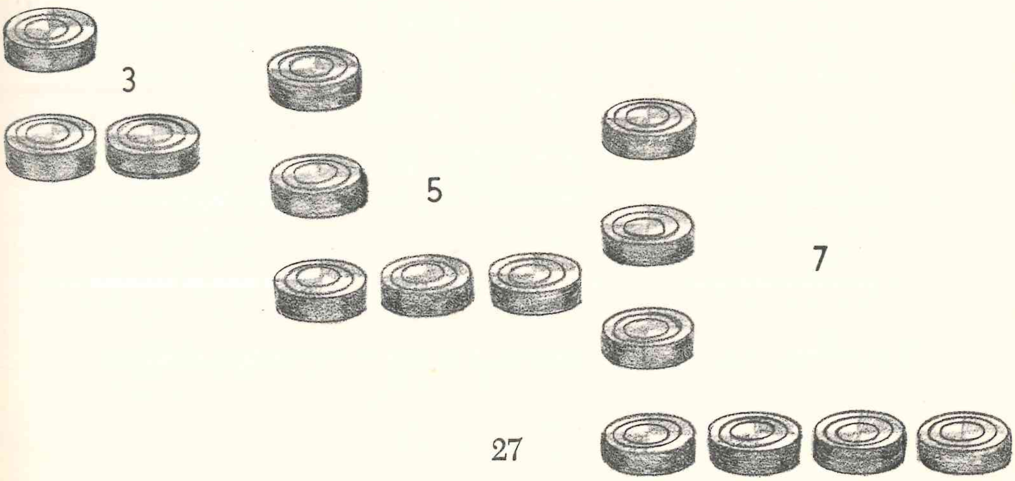
Some numbers can be used to make rectangles with two rows. We call them *even numbers*. For example, two checkers can make a rectangle with two rows, with only one checker in each row. Four checkers can make a rectangle with two rows, with two checkers in each row. Six checkers can make a rectangle with two rows, with three checkers in each row. So 2, 4, and 6 are even numbers.



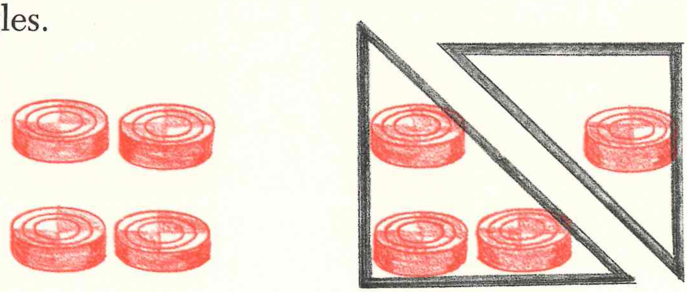
Even numbers

You can get all the even numbers in order by counting by 2's, starting with 2. What are the next five even numbers after 6?

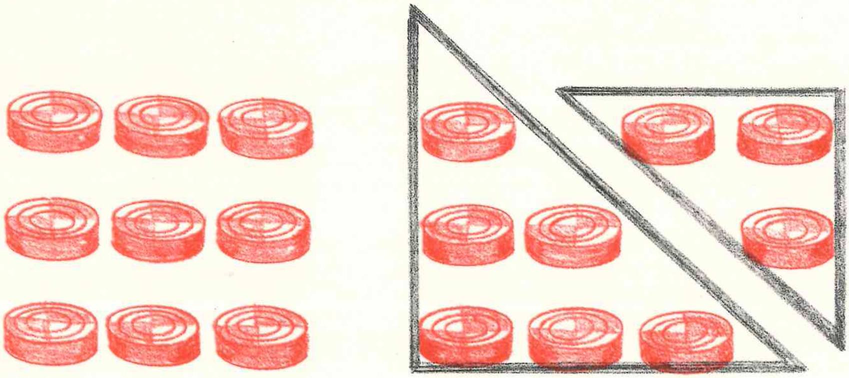
The counting numbers that are not even are called *odd numbers*. The first few odd numbers are 1, 3, 5, 7, and 9. All the odd numbers above 1 can be used to make an L-shaped figure in which the two sides of the L are equal. L's made with 3, 5, and 7 checkers are shown in the drawing.



There is an interesting connection between triangle numbers and square numbers. The first few triangle numbers are 1, 3, 6, 10, 15, 21, 28. Add any triangle number to the next higher triangle number, and you get a square number. For example: 1 + 3 = 4; 3 + 6 = 9; 6 + 10 = 16; 10 + 15 = 25. The drawing below shows why this happens. Each square is made up of two triangles.



4 = 3 + 1

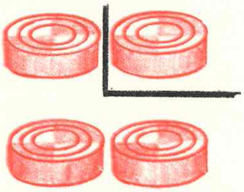


9 = 6 + 3

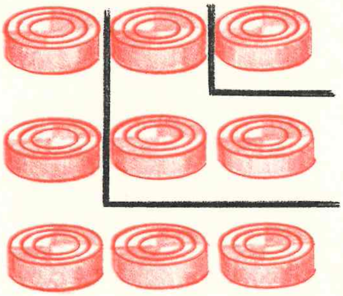
The square numbers are also related to the odd numbers. If you add all the odd numbers from 1 up to any other odd number, you always get a square number:

$1 = 1$
$1 + 3 = 4$
$1 + 3 + 5 = 9$
$1 + 3 + 5 + 7 = 16$

The drawing below shows why this happens. Each square can be broken up into L's. The number of checkers in each L is an odd number.



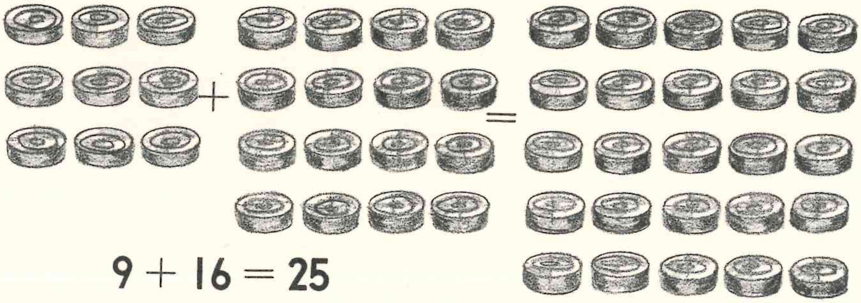
$4 = 1 + 3$



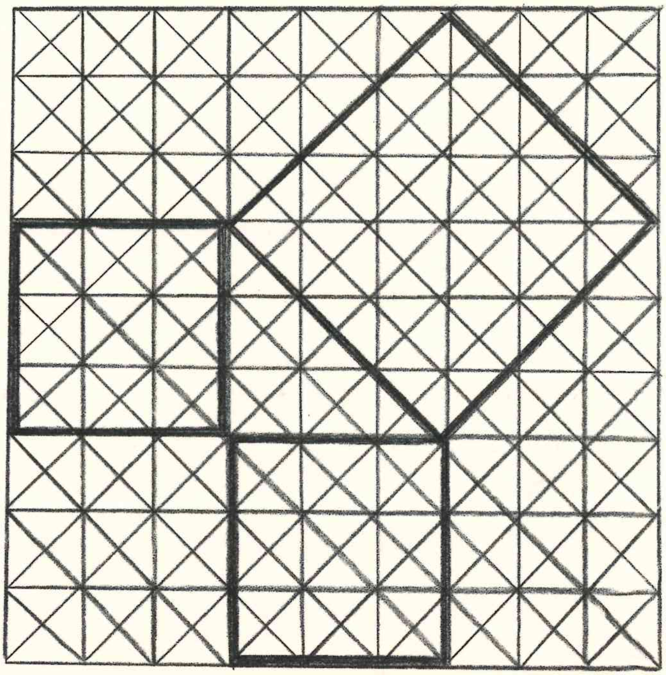
$9 = 1 + 3 + 5$

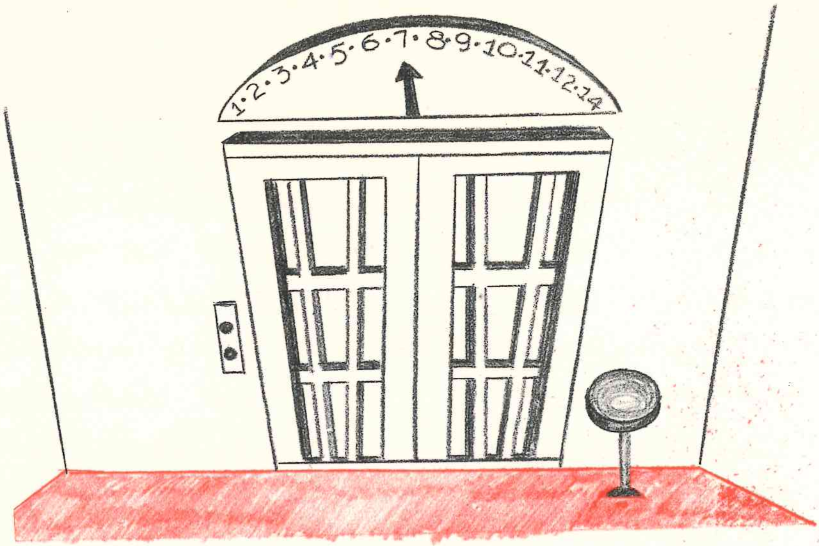
Two small squares are shown below. One has 9 checkers. The other has 16 checkers. The checkers in these two squares can be put together to form one large square. This happens because 9 + 16 = 25, and 25 is a square number. There are many pairs of square numbers that behave the same way: If you add them, you get another square number. For example, 25 and 144 are square numbers. When you add them, you get 169, which is also a square number. Besides 9 and 16, there is another pair of square numbers between 1 and 100 whose sum is also a square number. See if you can find this pair of numbers.

The three squares with 9, 16, and 25 checkers can be placed near each other so that their sides form a triangle. Then one corner or angle of the triangle will be like the



angles in a square. An angle like that is called a *right angle,* and the triangle it is in is called a *right triangle.* When you add the number of checkers in the squares on the two smaller sides of this right triangle, you get the number of checkers in the square that is on the largest side. Over two thousand years ago, people found out that this is true for all right triangles. They saw this fact for the first time by looking at floors paved with tiles. The picture below shows you what they saw. A right triangle, and the squares on its sides are outlined by heavy lines. Count the tiles in each of the three squares. You will see that if you add the number of tiles in the two smaller squares, you get the number of tiles in the largest one.



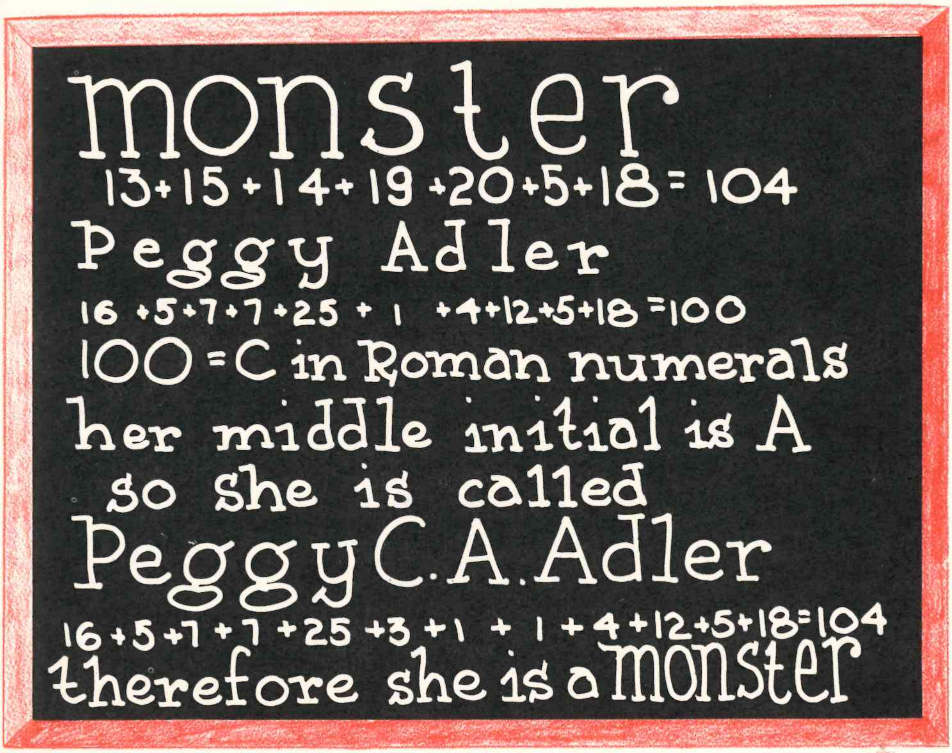


Lucky and Unlucky Numbers

A long time ago, people used to think that some numbers were lucky, and others were unlucky. The Greeks thought that all odd numbers were lucky, and all even numbers were unlucky. Many ancient peoples thought of the number seven as a very special lucky number. This may have been because there were seven bodies they could see moving across the sky: the Sun, the Moon, and the planets Mercury, Venus, Mars, Jupiter, and Saturn. We know now that there are other planets, too: Neptune, Uranus, and Pluto. We can see them through a telescope. The ancient peoples never saw them because they did not have telescopes.

Many people think of the number 13 as an unlucky number. For this reason, in some buildings, the floor above the 12th floor is called the 14th floor. Beliefs like these are foolish. No number is really lucky or unlucky.

A few hundred years ago, some people used to look for hidden meanings in names or words. They let each letter of the alphabet stand for a number, the way the Greeks or the Hebrews did. Then by adding the numbers that belong to the letters of the word, they got a number for the word. If the number was lucky or unlucky, they thought the word was lucky or unlucky. They called this way of finding lucky or unlucky numbers *gematria.* To find a number for your name, let A stand for 1, B stand for 2, and so on. By this scheme, the number for Charles is 3 + 8 + 1 + 18 + 12 + 5 + 19 = 66.



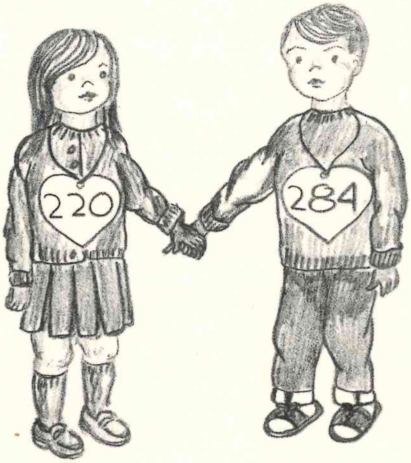
monster
13+15+14+19+20+5+18=104
Peggy Adler
16+5+7+7+25+1 +4+12+5+18=100
100=C in Roman numerals
her middle initial is A
so she is called
Peggy C.A. Adler
16+5+7+7+25+3+1+1+4+12+5+18=104
therefore she is a monster

You can divide 6 by 1, 2 and 3. 1, 2, and 3 are all smaller than 6. If you add them, you get 6. Because of this fact, 6 is called a *perfect number*. A perfect number is a number that is equal to the sum of all of the numbers that divide into it except itself. Perfect numbers are very rare. Only seventeen of them have been found so far. All seventeen of them are even numbers. No one knows whether there are any perfect numbers that are odd.

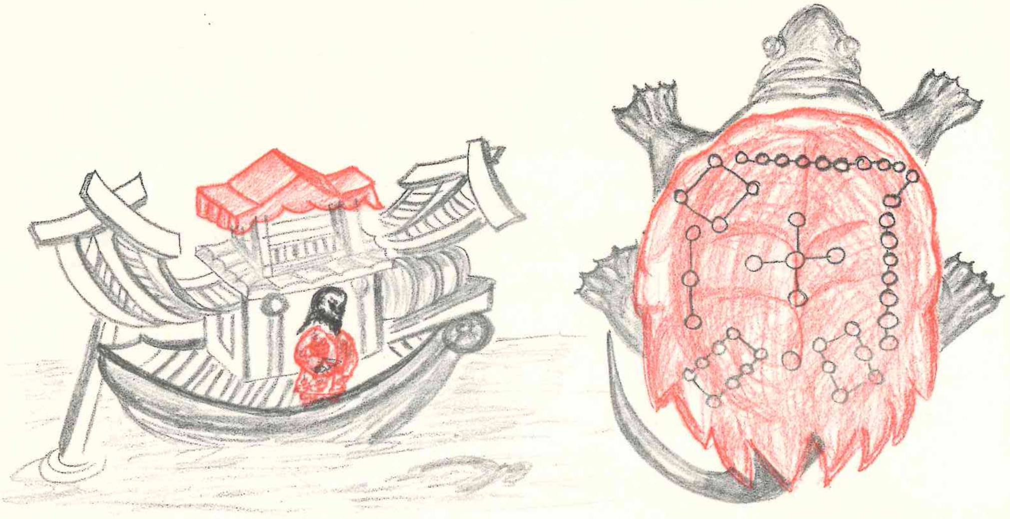
There is a simple rule for finding the even perfect numbers. It uses the numbers 1, 2, 4, 8, 16, 32, and so on. In this set of numbers, each number after the first one is double the one before it. Write down the first part of this set and stop at any number you like. Add the numbers you have written down. If the sum is a *prime* number, multiply it by the last number you wrote down. The result will be a perfect number. This rule is used below to find the first four perfect numbers.

$1 + 2 = 3$ $\quad 3 \times 2 = 6$
$1 + 2 + 4 = 7$ $\quad 7 \times 4 = 28$
$1 + 2 + 4 + 8 + 16 = 31$ $\quad 31 \times 16 = 496$
$1 + 2 + 4 + 8 + 16 + 32 + 64 = 127$ $\quad 127 \times 64 = 8128$

The numbers 220 and 284 are related to each other in an interesting way. If you add all the numbers that divide into 220 (except 220), you get 284. If you add all the numbers that divide into 284 (except 284), you get 220. Each is the sum of the numbers that divide into the other. Two numbers that act this way are called *amicable,* or friendly numbers. Before the year 1636, 220 and 284 were the only amicable numbers known. The Arabs thought these numbers had a magic power that could make people love each other. If an Arab wanted someone to be his friend forever, he made two charms. He put the number 220 on one of them, and the number 284 on the other. Then he wore one of them, and gave the other to his friend to wear.



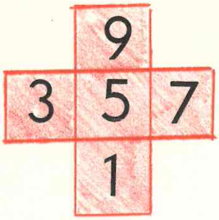
In 1636, a French mathematician found that 17,296 and 18,416 are amicable numbers. Almost 400 pairs of amicable numbers have been found since then. One pair, 1184 and 1210, was found by a sixteen-year-old Italian boy in 1866.



About four thousand years ago China was ruled by the Emperor Fuh-hi. A story about this emperor tells that once, when he got on board a boat on the Yellow River, he saw a large turtle in the water. A strange sign was written on the turtle's back. This sign is called the *lo-shu*. Each set of dots stands for a number. In the *lo-shu*, the numbers from 1 to 9 are placed in a square, like this:

4	9	2
3	5	7
8	1	6

Three by three magic square



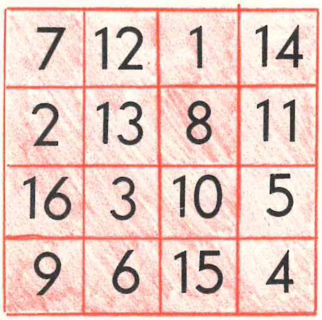
$9 + 5 + 1 = 15$
$3 + 5 + 7 = 15$
יה = 15

In this square, if you add the numbers in any row, or any column, or any diagonal, the sum is always the same. A square like this is called a *magic square*. Many people think it brings good luck.

The *lo-shu* was known to the Jews in ancient times. Each of its rows and columns adds up to 15. In Hebrew numerals, the number 15 spells the name of God. So the Jews thought the *lo-shu* had a special religious meaning.

If the even numbers are left out of the *lo-shu*, the numbers that are left form a cross. In some countries of the Far East this cross is worn as a charm.

There are other magic squares that use more than nine numbers. Here is a magic square with the numbers from 1 to 16. The numbers in each row, column, and diagonal add up to 34.



7	12	1	14
2	13	8	11
16	3	10	5
9	6	15	4

Four by four magic square

Different Ways of Multiplying

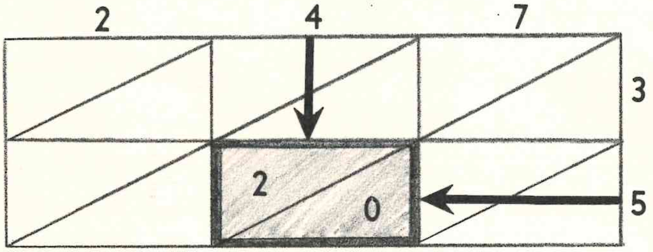
When we do an example in arithmetic, we arrange our work in a special way, and follow a special rule. There is a separate way for doing addition examples. There is another way for doing multiplication examples, and still another for division examples. These special ways of doing examples in arithmetic are called *algorisms*. The word comes from the name of an Arabian mathematician, al-Khowarizmi, who lived about one thousand years ago. He wrote a book on arithmetic. In the Latin language, his book was called *Liber Algorismi* (the book of al-Khowarizmi). Ever since then, his name has been used as the word for a way of doing an arithmetic example.

The algorism we use for multiplication is only one of many that work just as well. A few hundred years ago, the Italians used another algorism called the *grating method*. Here is an example to show how it was used. To multiply 247 by 35, first make a rectangle divided into rows of squares, with each square cut in half as shown in the drawing. Write 247 above the rectangle, and 35 on the right-hand side, with each digit next to a square. Now multiply 3 × 7. Write the product, 21, in the square that is alongside the 3 and under the 7. Write the 2 in the upper half of the square. Write the 1 in the lower half. In the same way, multiply each digit in 247 by every digit in 35. Put the product in the square that is alongside and under the digits that were multiplied. After all the boxes are filled in, add the numbers that are in each diagonal strip. The lowest strip has only the number 5 in it. So write 5 under that strip. The next strip has 1, 3, and 0 in it. So write 4 under that strip. After all the strips are added, you have the digits 0, 8, 6, 4, 5 arranged outside the grating, in that order. So 8,645 is the answer.

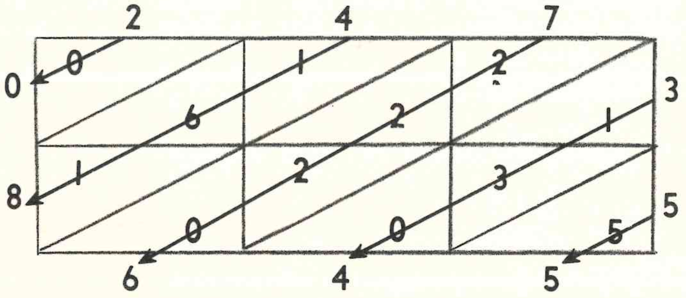
$$\begin{array}{r} 247 \\ \times 35 \\ \hline 1235 \\ 741 \\ \hline 8645 \end{array}$$

How we multiply 247 by 35

The same example done by the grating method

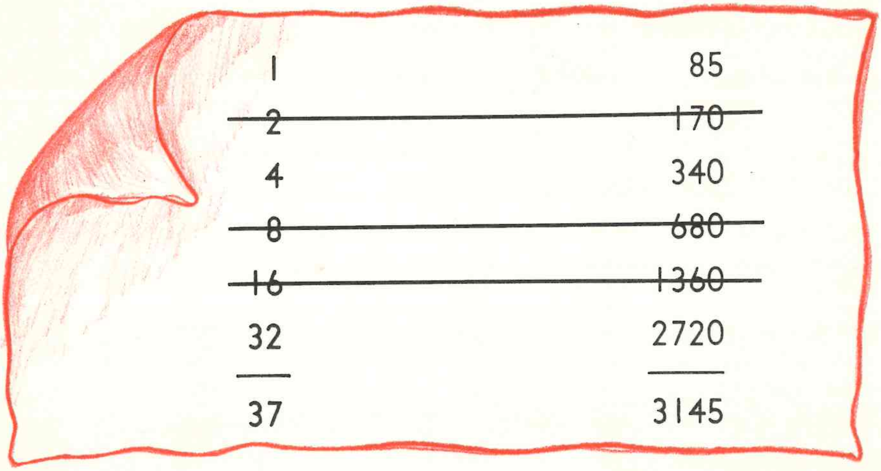


Multiplying the digits

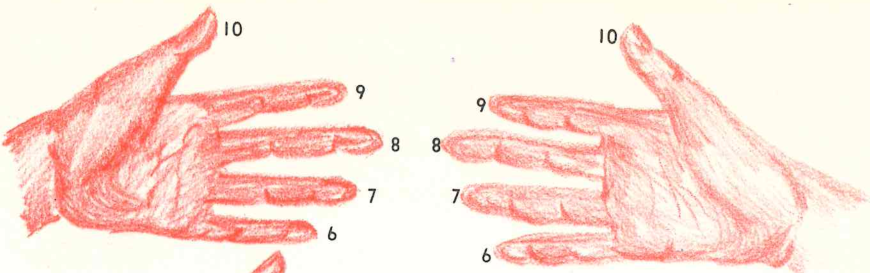


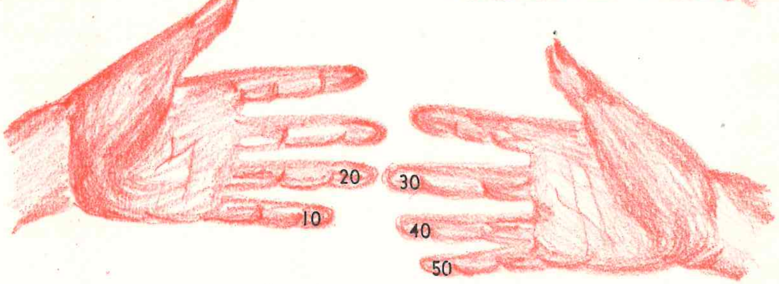
Adding the products

Suppose you forgot all the multiplication tables except the "two times" table. You would still be able to multiply any two numbers. You could use an old algorism invented by the Egyptians. This is how you would multiply 37 and 85. First write down the numbers 1 and 85, with a space between them. Two times 1 is 2. Write the 2 under the 1. Two times 85 is 170. Write the 170 under the 85. Two times 2 is 4. Write the 4 under the 2. Two times 170 is 340. Write the 340 under the 170. Keep on doing this until you have enough numbers on the left-hand side so that some of them add up to 37. This will happen when you have written down 32. The sum of 1, 4 and 32 is 37. You do not use the 2, 8, and 16 to get 37. So cross out the lines with 2, 8, and 16 in them. The sum of 85, 340 and 2720 is the product of the two numbers you started with. The example below shows how the Egyptians found that 37 × 85 = 3145.



1	85
~~2~~	~~170~~
4	340
~~8~~	~~680~~
~~16~~	~~1360~~
32	2720
37	3145





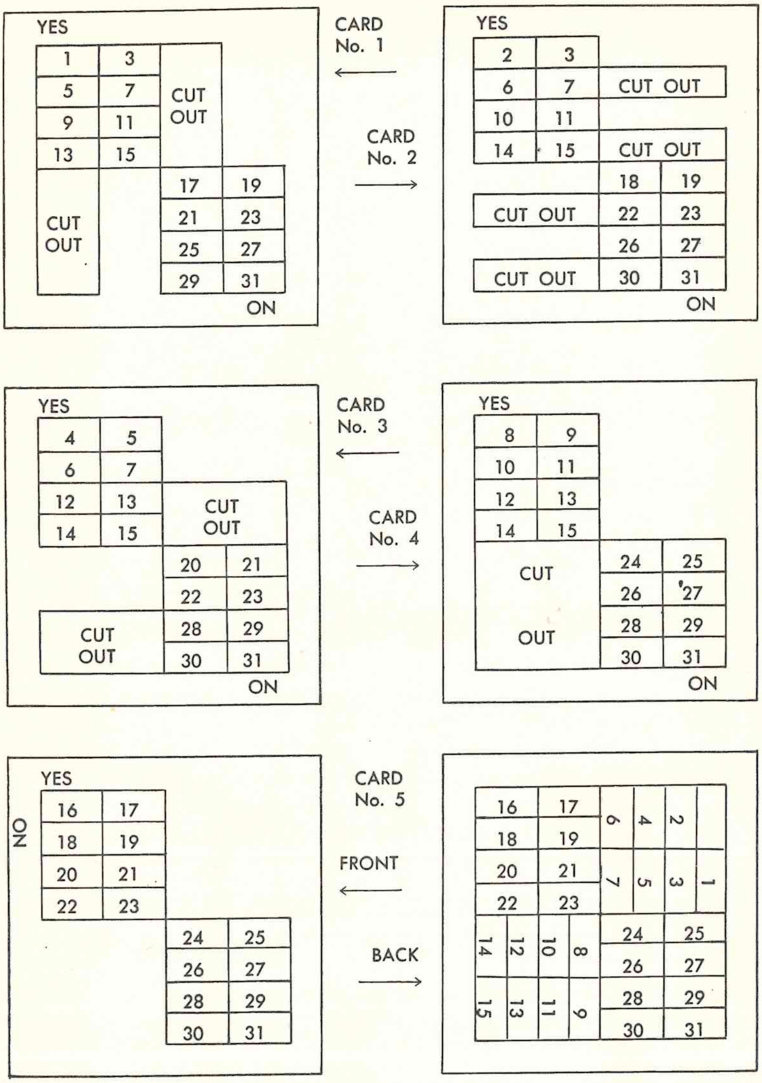
7 x 8

There is a way of multiplying on your fingers. Peasants in Europe sometimes multiplied this way. It works only for numbers from 6 to 10. Each finger on each hand stands for a number, as shown in drawing number 1, above. To multiply two numbers, like 7 and 8, let a 7-finger touch an 8-finger, as shown in drawing number 2. Now you get the product in two parts. To get the first part, count by tens on the fingers that touch and the fingers that are below them. In the case shown in the drawing, you get 50. To get the second part, count on each hand the number of fingers that are above those that touch. Then multiply these two numbers. In this case, you get 3 × 2 = 6. Now add the two parts: 50 + 6 = 56. Try this with some other numbers from 6 to 10. You will see that it always works.

Number Tricks

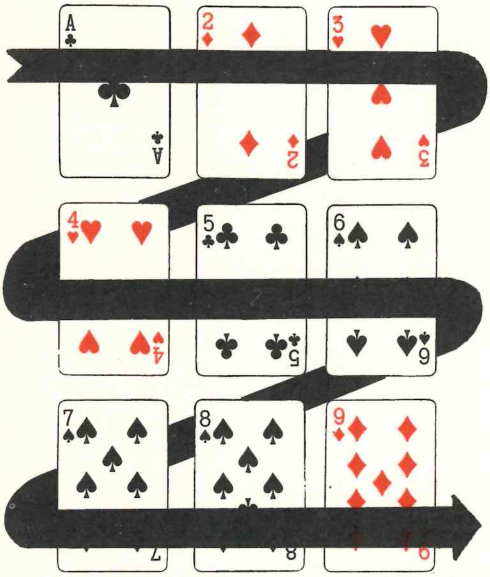
There are many tricks that can be done with numbers. Here is a trick in which you "read a person's mind." You use a special set of cards to guess a number that he has in mind. To make these cards, use the drawings on page 43 as a guide. There are five cards. Each one is a square, five inches long and five inches wide. Make the borders one half inch wide. Make the spaces in which the numbers are written one half inch wide and one inch long. The boxes marked "cut out" should be cut out with a sharp knife or razor. They will be windows in the cards. Card number five has something written on both sides. After you do the front of the card, turn it over sideways to get it in place for doing the back. Be sure that the top edge is still on top after you turn it over.

When the cards are finished, this is how you use them. Ask somebody to pick a number from 1 to 31. Then show him the cards, one at a time, starting with card number 1. Ask him if his number is on the card. If he says "yes," place the card on the table with the word "yes" on top. If he says "no," turn the card so that the word "no" will be on top. Place the cards in one pile, on top of each other, on the table. When the fifth card is in place, turn the whole pile over. The number you are supposed to guess will show up through a window in the cards.

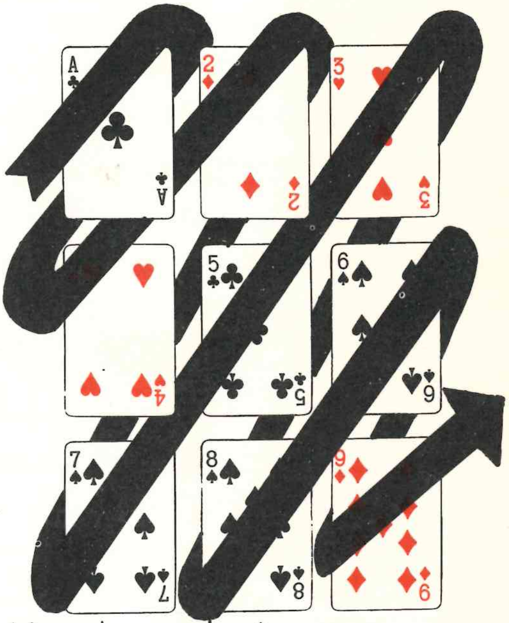

CARD No. 1
YES
1 3
5 7
9 11
13 15
CUT OUT
CUT OUT
17 19
21 23
25 27
29 31
ON
YES
2 3
6 7
10 11
14 15
CUT OUT
CUT OUT
18 19
22 23
26 27
30 31
CUT OUT
CUT OUT
ON
CARD No. 2
CARD No. 3
YES
4 5
6 7
12 13
14 15
CUT OUT
20 21
22 23
28 29
30 31
CUT OUT
ON
YES
8 9
10 11
12 13
14 15
CUT OUT
24 25
26 27
28 29
30 31
ON
CARD No. 4
CARD No. 5
FRONT
BACK
YES
ON
16 17
18 19
20 21
22 23
24 25
26 27
28 29
30 31
16 17
18 19
20 21
22 23
6 4 2
7 5 3 1
14 12 10 8
15 13 11 9
24 25
26 27
28 29
30 31

Here is an easy guessing trick that you can do with playing cards. Use nine cards, with the numbers from 1 to 9. Place them in one pile, face down, with the 1 on top. Now lay them out, face down, on a table to form a square, in this way: Put the first three cards in the first row, from left to right. Put the next three in the second row. Put the last three in the third row. The first drawing on page 45 shows how the cards will be set out. You will not see the numbers, because the cards will be face down. Now pick up the cards again along diagonal lines, starting with the upper left-hand corner. The order in which you pick them up is shown in the second drawing. Place each card you pick up under those you picked up before. Now lay the cards out in a square in the same way that you did before. Do all this over again if you like. The cards are no longer in their old order. In spite of that, if someone names a card, you will be able to pick it up at once and give it to him.

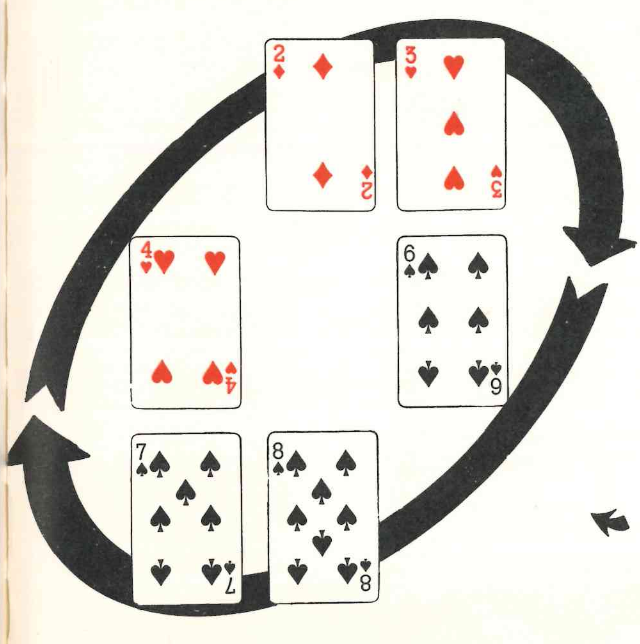
Here is how you know where to find the cards. The 1 will always be in its old place, in the upper left-hand corner. The 9, too, is in its old place, in the lower right-hand corner. The 5 is in its old place in the middle of the square. All the others cards, in their old places, formed a ring, as shown in the third drawing. To find the new place of any card in the ring, start with its old place, and move around the ring. Move one space clockwise for each time that you went through all the steps of laying out the cards and picking them up again. If you went through the steps twice, each card will be two spaces away from its old place.



How the cards are first put down



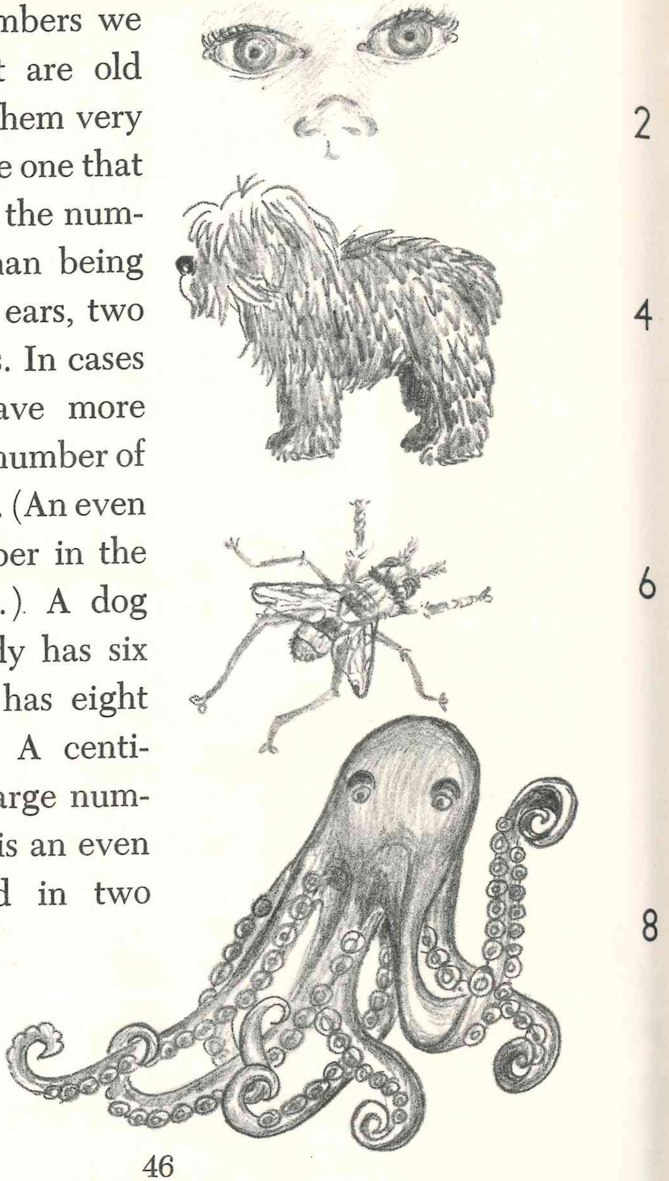
How the cards are picked up



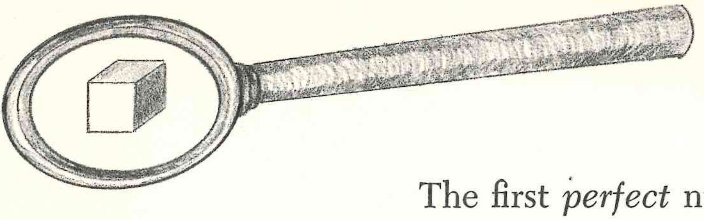
How the cards move

Numbers in Nature

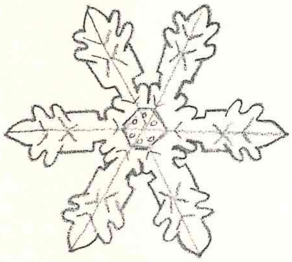
Some of the numbers we have talked about are old friends. We meet them very often in nature. The one that is most common is the number 2. Every human being has two eyes, two ears, two arms, and two legs. In cases where animals have more than two legs, the number of legs is always even. (An even number is a number in the "two times" table.). A dog has four legs. A fly has six legs. An octopus has eight leg-like tentacles. A centipede has a very large number of legs, but it is an even number, arranged in two equal rows.

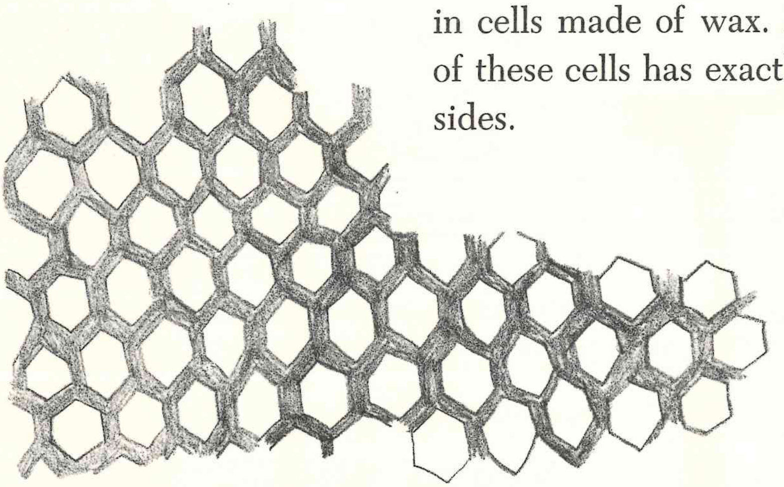


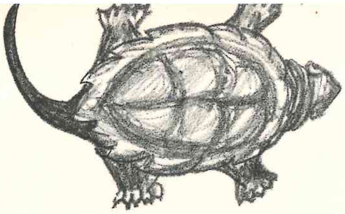
Even numbers in nature

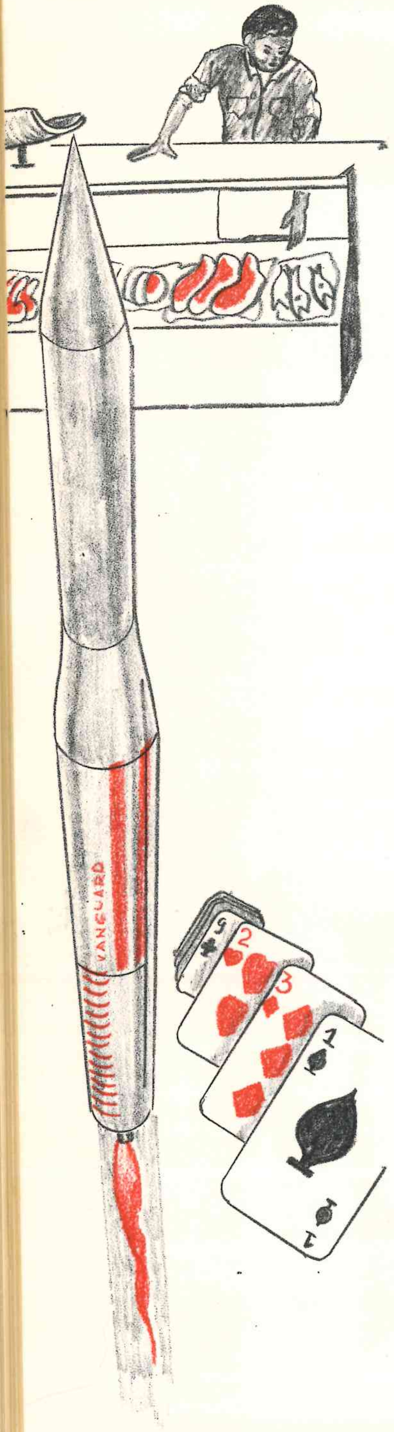


The first *perfect* number, 6, appears in many places in nature. Look at a crystal of table salt under a magnifying glass. You will see that each crystal is a cube, with six faces. Snowflakes are ice crystals. They have many beautiful shapes. All the snowflake patterns have six sides. A bee stores its honey in cells made of wax. Each of these cells has exactly six sides.







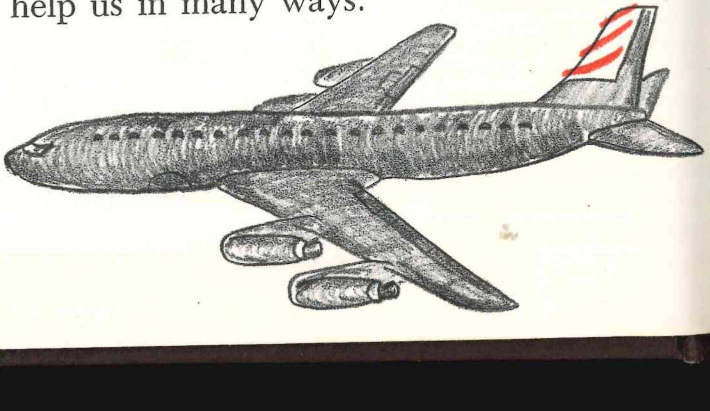


Numbers Help Us

At work, we often have to count, or measure, or calculate. The butcher weighs the meat he cuts. The carpenter measures the wood he saws. We all count our money when we buy or sell something. When we do all these things, we use numbers. An airplane pilot uses numbers when he plots his course. A scientist uses numbers when he plans how to fire a rocket to the moon.

At play, we use numbers in many games, tricks and puzzles.

Numbers are useful tools that help us in many ways.



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